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EFFECT OF RETAINER DESIGN AND MATERIALS ON THE FRACTURE RESISTANCE OF ANTERIOR CANTILEVER RESIN BONDED FIXED DENTAL PROSTHESIS

Mohamed Osman Ali*, Nesma Mohamed Magdy Elgohary**,
Amal Abd El-Samad Sakrana*** *and* Walid Abd El-Ghafar Al-Zordk***

ABSTRACT

Aims & Background: Resin-bonded fixed dental prostheses (RBFDPs) are a conservative and minimally invasive treatment option for replacing missing tooth, particularly in the anterior region. This study aimed to evaluate the effect of retainer design and material type on the fracture resistance of anterior cantilever RBFDPs.

Materials and methods: Forty-eight sound human maxillary canines were collected, divided into two main groups based on retainer design (conventional palatal wing, groove modification palatal wing, and box modification palatal wing) and material type (zirconia and lithium disilicate). The RBFDPs were fabricated using CAD/CAM technology, cemented with resin cement, and subjected to 10000 thermal cycles. Each specimen was subjected to axial loading until fracture using a universal testing machine. For each specimen, the failure load was recorded and failure mode was studied. Representative specimens were studied using scanning electron microscope. Data was analyzed using Two-way ANOVA was used to analyzed the combined effect of the study variables followed by the post hoc Tukey test (α=.05).

Results: The results showed that zirconia RBFDPs with groove modification exhibited the highest fracture resistance (265.57 ±27.42 N), while lithium disilicate RBFDPs with box modification showed the lowest fracture value (164.28 ±27.32 N). Two-way ANOVA test revealed a significant combined effect (P=.001) of design and material type. Adhesive failure was more common with zirconia compared to lithium disilicate which exhibited more fracture of connector failures.

Conclusion: Both material and design significantly affect the fracture resistance of RBFDPs, with groove-modified zirconia RBFDPs being the most resistant to fracture.

KEYWORDS: Resin-bonded fixed dental prosthesis, Zirconia, Lithium disilicate, Fracture resistance, Retainer design.

* Postgraduate Student, Department of Fixed Prosthodontics, Mansoura University, Mansoura, Egypt
** Associate Professor, Department of Fixed Prosthodontics, Mansoura University, Mansoura, Egypt
*** Professor, Department of Fixed Prosthodontics, Mansoura University, Mansoura, Egypt

INTRODUCTION

Replacement of missing teeth is considered an urgent need not only to restore function but also to restore appearance. This includes implant, fixed resin-bonded restorations, and conventional fixed restorations.[1-3]

Full- coverage crown preparations can result in adverse effect on tooth vitality with loss of 65% to 75% of the sound structure of teeth. Less invasive and more effective treatments, such as resin-bonded fixed dental prosthesis (RBFDP), are recommended, especially if the adjacent teeth are defect-free.[4-7] Rochette first described RBFPD in 1973 as a double-sided perforated metal-reinforced caps on the lingual/palatal side. These caps are bonded to the abutment tooth's enamel using acrylic resin, thereby providing macroscopic mechanical stability.[8]

The design of the RBFDP has evolved over time, from metal-ceramic to all ceramic, from fixed-fixed to cantilever designs, and from perforated to non-perforated retainers.[9] These changes are the result of significant advances in connectivity, materials, and esthetics, all of which have undoubtedly impacted choice and design.[10] The desire for an esthetic appearance is reflected in the fact that RBFDP is more successful in the maxillary arch than in the mandibular arch and in the anterior teeth than in the posterior teeth. [11]

The RBFDPs are a minimally invasive method of replacing missing teeth. One of the main advantages of this treatment modality is that they are a non-invasive, stable, and inexpensive option that can replace missing teeth and preserve tooth structure.[1] The overall survival rate of RBFDPs is similar to that of traditional bridges.[12] RBFDPs are the most conservative as they only aim to remove up to 14% of the tissue. This is in contrast to full-coverage ceramic preparation, which removes up to 75% of the tooth structure.[4-6] Comparisons between RBFDP and implant-supported prostheses have shown that their longevity is similar. No significant difference in overall treatment satisfaction was seen between patients who received RBFDP and implants. [4-6]

When the single retainer design was introduced in 1997 as an alternative to the traditional double retainer design. The effectiveness of RBFDP has been greatly improved.[2,14,15] Studies showed that cantilevered ceramic RBFDPs were superior to fixed-fixed ceramic RBFDPs in terms of survival, separation, and fracture rates.[14] After five years, the cantilever RBFDP had better clinical outcomes than the fixed RBFDP.[4] According to clinical and in vitro studies, the retainer region is where prosthesis fractures most frequently occur.[2] The fracture resistance and retention of RBFDPs were suggested to be influenced by the retainers' overall dimensions, shape, length, and construction material.[2]

The modified designs of RBFDPs reduced the lateral stress on the retainers when the restoration was loaded non-axially by increasing the enamel bonding surface area and providing a more advantageous stress distribution.[16,17] This is confirmed by in vitro tests showing encouraging results and improved enamel adhesion.[18] It was revealed that single-retainer designs produced better clinical results in anterior RBFDPs.[1,5] After ten years, the survival percentage for anterior single-retainer RBFDPs was 94.4%, while the survival rate for the double-retainer design was 73.9%. [19]

By using monolithic high-translucent zirconia, with no doubt, advantageous when viewed from the front, because small metal wings with enamel are sometimes visible on the metal-ceramic front of RBFPDs, but not on those with zirconia.[20] The survival rate for all-ceramic permanent dental restorations was tested in several studies and proved promising results.[21,22] On the other hand. Lithium Disilicate showed excellent longevity of cantilever RBFDPs over 10–20 years with few mechanical complications and maintained aesthetic properties.[23]

Before moving on to clinical research, in vitro investigations are crucial for establishing the foundation of treatment Osman et al. came to the conclusion that there were clearly few research that concentrated in vitro investigations on all ceramic cantilevered RBFDPs that were especially concerned with its specifications and retainer design.[24] This in vitro study aimed to examine the fracture resistance and failure modes of anterior cantilever RBFDPs made of zirconia and lithium disilicate material with various designs. The null hypothesis was that there would be no effect of retainer design and materials of fracture resistance of RBFDP replacing a missed anterior tooth.

MATERIALS AND METHODS

The used materials are presented in Table 1. Sample size calculation was determined based on previous research.[25] Using software program (Power and Sample Size Calculations v3.1.2; Informer Technologies, Inc), a sample of at least 5 in each group was required to provide a power of 90 %. The Type I error probability associated with this test was 0.05. By adding 10% to compensate for possible error then total sample size will be 6 for each group.

48 sound human teeth were randomly divided into 2 main groups (n=24) according to the type of ceramic material: Teeth received Lithium Disilicate

TABLE (1) Materials used.

Material	Product	Patch No.	Composition		Manufacturer
Lithium disilicate glass Ceramics	IPS e.max Press	ZC010WC	SiO_2 Li_2O P_2O5 ZrO_2 AL_2O_3 CeO_2 Tb_4O_7	58% 18,5% 5% 10,1% 10,9% 2% 1%	Ivoclar, Switzerland
Zirconia ceramic discs	Nacera	5121124	$ZrO_2 + HfO_2 + Y_2O$ Y_2O_3 $Al_2\,O_3$ Other oxides	≥99,0 < 6 < 0,5 < 1	Dental Direkt, Germany
Dual Polymerizing resin cement.	RelyX Unicem-2 Auto mix	11312083	Powder: -Fluoroaluminosilicate (FAS) glass - Potassium persulfate - Ascorbic acid - Opacifying agent Liquid: -Methacrylated polycarboxylic acid - Water - HEMA - Tartaric acid		3M ESPE, USA
Ceramic Primer	Monobond N	Z03CXK	- Alcohol solution of saline methacrylate - Phosphoric acid methacrylate - Sulphide methacrylate.		Ivoclar vivadent, Germany
Ceramic etchant	Condac porcelaina	100122	9% Hydrophluric acid		FGM dental, Brazil

RBFDP (L) and Teeth received Zirconia RBFDP (Z). Each group was farther subdivided into three subgroups according to preparation design (n=8): Conventional palatal wing (CON), Palatal wing with grooves modification (GR), and Palatal wing with box modification (BO).

This study followed all guidelines by the local research ethics committee of faculty of dentistry Mansoura university and received approval No. A0105023FP. 48 caries free upper canines which were extracted for periodontal reasons in the oral maxillofacial surgery department, Mansoura University, Egypt were collected. Written informed consent was obtained from all patients to allow the use of their extracted teeth. Teeth were scaled, cleaned with rotary brush and pumice then stored in distilled water at temperature between 5°C and 10°C. The dimensions of selected teeth were measured using a digital caliper (Neiko 01407A, China). A range of 10 ±1 mm inciso-cervical, 7 ±1 mm mesio-distal at middle third of tooth, 5 ±1 mm mesio-distal at cervical level are selected, all teeth above or below these ranges were excluded. Selected teeth were examined for cracks or fracture lines using magnifying lens. Any teeth with abnormal shape were excluded.[26,27]

Teeth preparation and laboratory fabrication: For CON group, a horizontal preparation of 0.8-1 mm was done using small diamond chamfer bur (ISO# 101, SF101) with the finish line 1 mm incisal to CEJ and 1 mm apical from the incisal edge (Figure 1). For GR group, same steps as CON group with the addition of shallow groove 0.5 mm in depth in vertical direction to long axis of tooth and positioned on the proximal termination of the conventional preparation (Figure 2). For BO group, same steps as CON group with addition of proximal box measuring 1 mm in depth in vertical direction to long axis of tooth and positioned on the proximal termination of the conventional preparation (Figure 3). Diamond flame bur was then used to reduce the palatal surface within the limitation of outline of preparation. With the exception of proximal boxes, all preparations were restricted to enamel.[28]

Teeth were then imported in CAD/CAM virtual environment by laboratory scanner (Dof-EDGE, South korea). Using a CAD software (Exocad DentaCad, Darmstad, Germany), one master model of RBFDP with a cantilevered single-retainer was selected. Retainer wing with uniform thickness was 0.8 mm and connector has been designed of uniform height of 3 mm with 1.5 mm width, leaving 2 mm space between pontic and acrylic blocks holding abutment tooth. Then 0.5 mm groove or 1 mm box added according to the selected teeth groups (Figure 4).

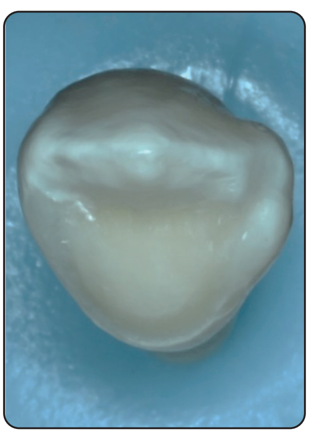

Fig. (1) Group CON.

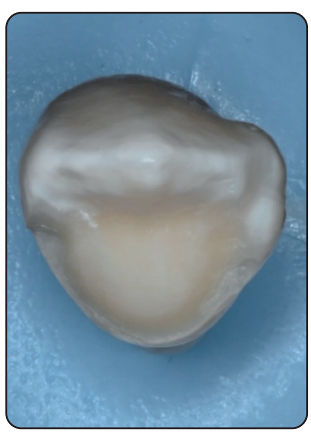

Fig. (2) Group GR.

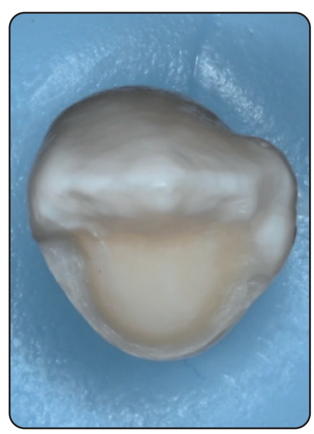

Fig. (3) Group GR.

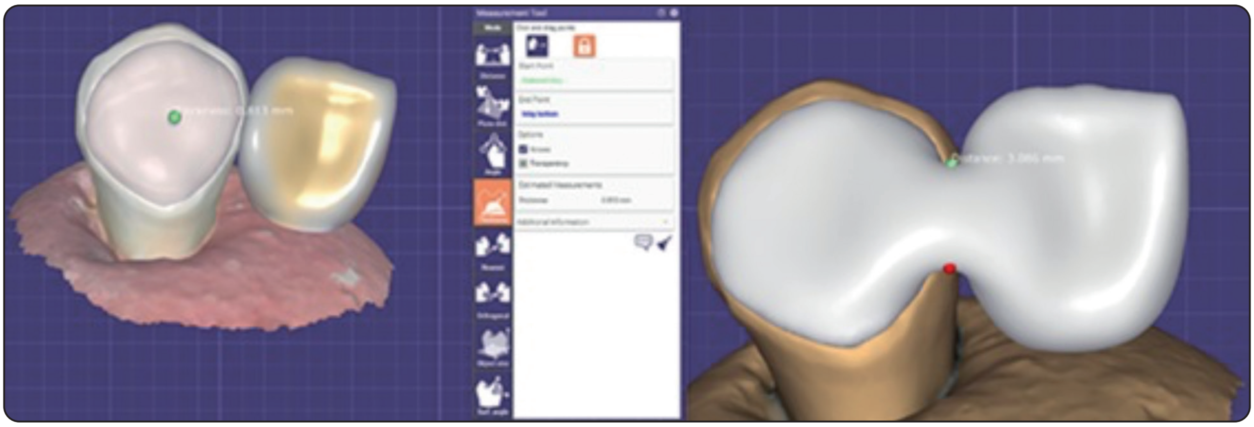

Fig. (4) CAD/CAM Designing

Each RBFDP was produced using the same CAD design, but depending on the material type, multiple processes were used. The 24 zirconia RBFDPs were milled by a (Imes Core, CORITEC 250i, Canada) polished using diamond burs, and sintered in special furnace (Mihm-Vgot version, Tabeo, Germany) with temperature rising to 1550 ºC with rate of 10 ºC/min within approximately 3 hours and holding time of 2 hours, then cooling to room temperature following the manufacturing instructions. Wax loss procedure was applied for the fabrication of the 24 lithium disilicate RBFDP. The RBFDPs were milled from a wax block (Yeti Dental, Germany). Each RBFDP was sprued to its cantilever tooth by a single piece of wax. Subsequently, those were invested into a universal investment material (Beliavest SH, Pego, Germany). The investment was preheated for 75 minutes at 850 ^{O}C, and then the ceramic material was pressed using a high translucency pellet in a combi press machine (Vita Vacumat 6000, Vita Zahnfabrik, Germany). Lastly, each restoration was finished and cleaned according to the manufacturer's specifications before undergoing the glaze firing process.

Zirconia surface treatment was done with Air borne particle abrasion using alumina particles (50 microns) at 30 psi from 10 mm distance to the fitting surface of RBFDP. Lithium Disilicate surface treatment was done with Hydrofluoric acid (9%) (Condac porcrlana, FGM dental group, Brazil) applied to the fitting surface of each RBFDP for 1 minute then rinsed with water spray and dried according to manufacturer's instructions. 37% phosphoric acid (K-etchant, Kuraray Noritake Dent., Japan) was used to prepare the teeth by etching the enamel fitting surface for 30 seconds.[28,29]

Resin cement was applied via auto-mixing syringe on the fitting surface of prosthesis (RelyX, 3M ESPE, USA). The PBFDP was seated on the tooth prepared area with a sticky plastic stick (Micro-stix, Microbrush international, United Kingdom) and the excess of resin cement was immediately removed with a small brush and light cured for 3 seconds for each side (Mesio-palatal, Disto-palatal) using polymerization light (Woodpecker, Germany) at distance of 10 mm with intensity of 650 mW/cm^2. The excess cement was removed with a manual scaler. Specially designed cementation device was modified and used to make a constant load of 250 gm at right angle to palatal surface of prosthesis while specimen is fixed in its position by its acrylic base in customized Teflon holder. Force is delivered by rigid Teflon arm with its tip shaped as negative replica of the outer surface of wing part of RBFPD. Then second application of light cure for 20 seconds.[30,31]

All the cemented specimens were stored in distilled water at 37°C for 24 hours. Later, they were subjected to 10,000 cycles of thermal cycling using (THE-100 SD Mechatronic thermocycler, German), with 15 second water bath and 5 second transition period. [31-33]

Following artificial fatigue tests, each specimen was fit in specially designed mounting device that allowed the pontic to be loaded in 135° on the palatal surface. The fracture resistance test was performed using Universal testing machine (Instron universal testing machine model 3345, England). The load application was fixed at a cross-head speed of 1 mm/min until fracture. Reading of test were recorded using computer software (bluehill Instron, England) (Figure 5).[9,31]

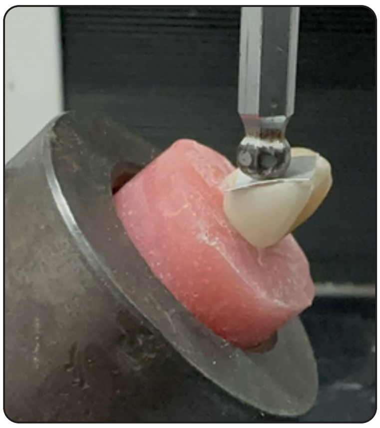

Fig. (5) Fracture testing

Qualitative assessment of the fractured / failed specimen was done using a 40× magnification stereomicroscope. Four-examiner agreements were used to describe and classify the failure modes. SEM (Model FEI Quanta 200i, FEI Company, USA) was used to assess images of the fractured surfaces of the objects. Modes of failure were classified according to nature of failure as follow: fracture of connector, adhesive failure, and catastrophic failure.[40,42]

Data analysis was performed using SPSS software, version 26, PASW statistics for Windows version 26. Chicago, Illinois: SPSS Inc. Quantitative data were presented as mean± standard deviation for normally distributed data. The significance of the results was considered at the 0.05 level.

RESULTS

Two-way ANOVA test was used to assess combined effect of change in material and design. Change in design including Conservative design, Groove modification design, Box modification design have statistically significant effect on fracture resistance (P=.004) and also change in material including Zirconia and lithium disilicate have statistically significant effect on fracture resistance (P=.001) and combination between both independent factors (Table 2).

For Zirconia restoration; a statistically significant difference between studied designs (P<.001). Post Hoc Tukey test illustrates statistically significant difference between Conservative design versus Groove modification design (P<0.001), between Conservative design versus Box modification design (P=.02) and between Groove modification design and Box modification design (P=.012). Mean fracture resistance was highest among Groove modification design followed by Box modification design and the least for Conservative design (265.57 ±27.42 N, 228.97 ±35.42 N and 195.59 ±10.47 N, respectively) (Table 3,4) (Figure 6).

For Lithium disilicate restoration; a statistically significant difference between studied designs (p<0.001). Post Hoc Tukey test illustrates statistically significant difference between Conservative design versus Groove modification design (p=0.005), between Conservative design versus Box modification design (p=0.003) and between Groove modification design and Box modification design (p=0.001). Mean fracture resistance was highest among Groove modification design followed by Conservative design and the least for Box modification design (248.09 ±25.68 N, 207.48 ±25.49 N and 164.28 ±27.32 N, respectively) (Table 3,4) (Figure 6).

The fracture resistance of the RBFDPs varied significantly based on the material and retainer design. The highest fracture resistance was recorded in zirconia RBFDPs with groove modification (265.57 ±27.42 N), followed by zirconia with box modification (228.97±35.42 N) and conventional design (195.59±10.47 N). For lithium disilicate, the highest fracture resistance was observed in the groove modification subgroup (248.09 ±25.68 N), followed by the conventional design (207.48 ± 25.49 N) and box modification (164.28 ±27.32 N) (Table 3,4) (Figure 7).

TABLE (2) Two Way ANOVA for combined effect of change in material and design on fracture resistance.

Dependent Variable: Fracture resistance						
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**p value**	**Partial Eta Squared**
Corrected Model	54292.728[a]	5	10858.546	15.616	.001	.650
Intercept	2288100.147	1	2288100.147	3290.593	.001	.987
Designs	6588.047	1	6588.047	9.474	.004	.184
Materials	35764.909	2	17882.454	25.717	.001	.550
Designs * Materials	11939.772	2	5969.886	8.585	.001	.290
Error	29204.525	42	695.346	-	-	-
Total	2371597.400	48	-	-	-	-
Corrected Total	83497.253	47	-	-	-	-

a. R Squared = .650 (Adjusted R Squared = .609)

 # Design: Conservative design, Groove modification design, Box modification design, Materials: Zirconia and lithium.

TABLE (3) Post Hoc Tukey test for pairwise comparison between different materials.

(I) Materials	(J) Materials	Mean Difference (I-J)	Std. Error	p value	95% Confidence Interval	
					Lower Bound	Upper Bound
Conservative design	Groove modification design	-55.29*	9.32	.001*	-74.10	-36.47
	Box modification design	4.91	9.32	.601	-13.90	23.72
Groove modification design	Conservative design	55.29*	9.32	.001*	36.47	74.10
	Box modification design	60.20*	9.32	.001*	41.39	79.01
Box modification design	Conservative design	-4.91	9.32	.601	-23.72	13.90
	Groove modification design	-60.20*	9.32	.001*	-79.01	-41.39

***Statistically significant*

TABLE (4) Comparison of Fracture resistance between different designs

Conservative design	Groove modification design	Box modification design	Test of significance	Between group significance	
Zirconia	195.59 ±10.47	265.57 ±27.42	228.97 ±35.42	F=13.89 P<.001	P1<.001 P2=.02 P3=.012
Lithium disilicate	207.48± 25.49	248.09 ±25.68	164.28 ±27.32	F=20.51 P<.001	P1=.005 P2=.003 P3<.001

P is significant at P<.05
P1 is difference between Conservative design and Groove modification design.
P2 is difference between Conservative design and Box modification design.
P3 is difference between Groove modification design and Box modification design.

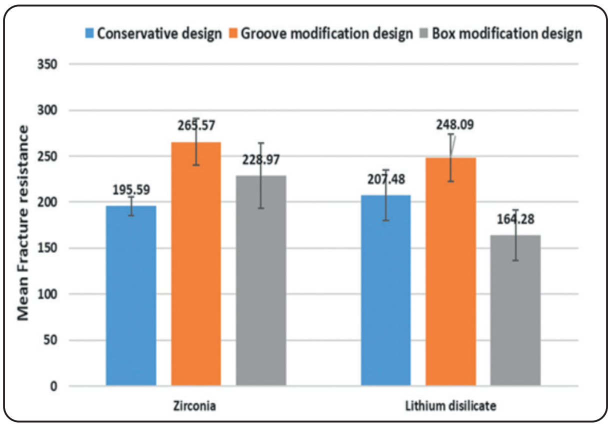

Fig. (6) Comparison of Fracture resistance between different designs for each material

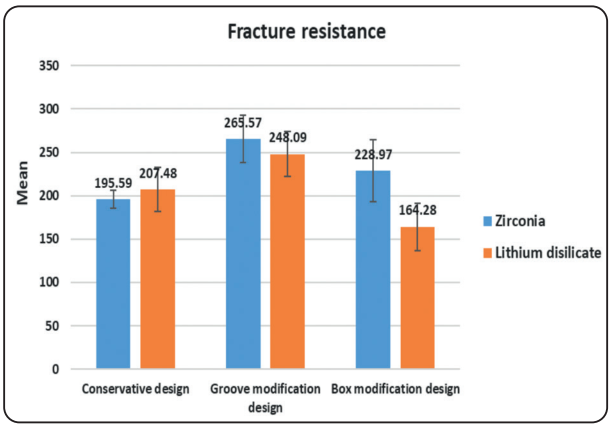

Fig. (7) Comparison of fracture resistance between different materials for each design

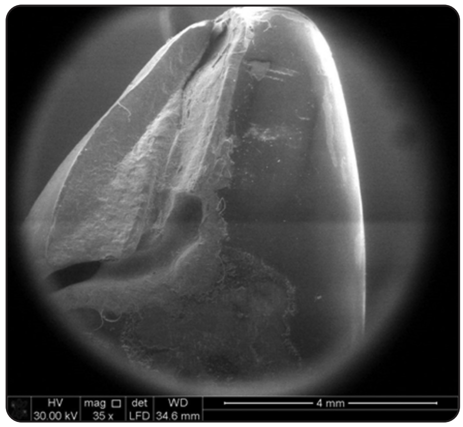

Fig. (8) Fractured restoration

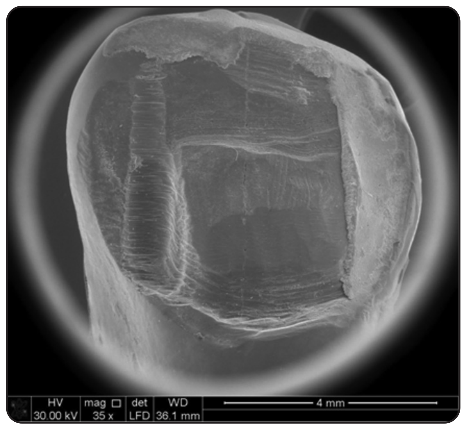

Fig. (9) Loss of adhesion

FAILURE MODES

Within each of studied mode of failures; no statistically significant difference between studied groups of material and designs. For LG subgroup; 62.5% fracture of connector failure, 25% adhesive failure and 12.5% catastrophic failure. For LB subgroup; 62.5% fracture of connector failure and 37.5% adhesive failure. For LC subgroup; 75% fracture of connector failure and 25% adhesive failure. For ZG subgroup; 62.5% fracture of connector failure and 37.5% adhesive failure. For ZB subgroup; 50% fracture of connector failure, 37.5% adhesive failure and 12.5% catastrophic failure. For ZC subgroup; 50% fracture of connector failure and 50% adhesive failure (Figure 8,9,10).

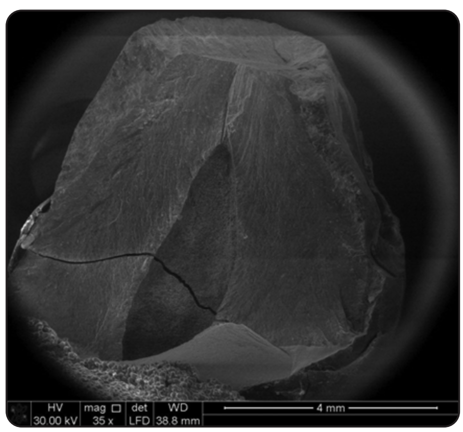

Fig. (10) Catastrophic fracture

DISCUSSION

The null hypothesis stated that there would be no effect of retainer design and materials of fracture resistance of RBFDP replacing a missed anterior tooth has been rejected.

It has been shown to be a viable option for treating and replacing missing teeth when conservative methods such as implant treatment are not possible. Furthermore, the large number of teeth that needed to be matched and the significant loss of tooth tissue made the choice of conventional fixed dental prosthesis a difficult choice.[26] RBFDP preparations are undoubtedly a better choice as they remove up to 14% of the tooth structure. This is in contrast to all-ceramic preparations, which remove up to 75% of the tooth surface area.[3]

Due to their superior appearance and similar material strength, monolithic zirconia and lithium disilicate are good alternatives to metal-ceramic RBFPPDs for use in the frontal region[34].

The 5-year survival rate of permanent dental restorations is 87% with zirconia restorations and up to 100% with glass ceramic restorations.[27] The ability to process zirconia using CAD/CAM technique offers better standardized thickness, accuracy of outcome, the ability to manufacture thinner materials and more conservative dental preparation.[24] Surface treatment for zirconia RBFDP is a combination of chemical and mechanical conditioning which is essential for good adhesion strength. Airborne-particle abrasion with silica-coated particles to allows the association of silane primers.[34] Surface treatment for lithium disilicate RBFDP was done using hydrofluoric acid (9%) prior to adhesive cementation.[35]

RelyX was used in this study as cementation material. Espindola-Castro et al. (2020) concluded that RelyX resin cement showed statistically significant differences in microhardness mean values compared to the other groups. Resin cement, like RelyX Unicem2, can affect the fracture load of zirconia crowns. They allow the cement to distribute stresses to the and prevent crack propagation through the crown, by providing additional reinforcement of the junction between dentin and crown.[30,31]

Accelerated aging based on thermos-cycling to match the circumstances in oral cavity. Thermal cycling mimics the physiological range of temperature provided in the oral cavity by hot or cold liquids [23] To mimic clinical fatigue cycles so, obtaining misleading readings based solely on compressive stress was avoided. Accordingly, in this study 10,000 thermal cycles were applied to mimic approximately 1 year in the oral cavity.[18,36]

Each specimen was fit in specially designed mounting device that allowed the pontic to be loaded in 135^{o} on the palatal surface so that actual occlusion direction is followed while testing in Universal testing machine.[31,37]

This study showed that modification of the design significantly influenced fracture resistance, of the same materials, change in material selection also had a significant difference in the impact on fracture resistance. The interactions of the two independent parameters also had statistical significance in impacting its fracture resistance. Among these, the mean of the fracture loads of the groove-altered zirconia material ranked the highest; the lowest value is for lithium disilicate box design.

Keulemans et al. (2008) agreed on the significant negative effect of Box modification for RBFDP. He concluded that Box modification was significantly lower than both designs while wing retained design and step box design showed acceptable fracture resistance. Also, catastrophic fracture was more noted with box modification. On the other hand, remaining designs showed connecter fracture and adhesion failure with no significance of any failure mode over another.[38]

Refaie et al. (2016) also reported significant change in fracture resistance after testing deferent preparation designs that included full coverage, partial coverage and groove modified partial coverage RBFDP, while no significant difference noted in changing of cementation materials. His results also pointed to the significantly higher resistance to fracture in modified groove modification design over conventional wing design.[31]

Choi et al. (2017) results further supported this study. He said that though no significant difference was found between the groups of lithium reinforced zirconia and monolithic zirconia in combination, yet a significant difference in fracture resistance did exist in the groups of lithium reinforced zirconia, 4943.87 ± 1243.70 N and monolithic zirconia, 2872.61 ± 658.78 N, and between the groups of monolithic lithium and monolithic zirconia, 4948.02 ± 974.51 N, P<.05.[39]

On the other hand, Di Fiore et al. (2020) stated that zirconia and Lithium Disilicate are not significantly different in affecting fracture resistance. Yet, his results showed superiority of zirconia over lithium disilicate. This disagreement in results outcome may be due to that Di Fiore tested only conventional design in his study. While in this study three designs were studied. Di Fiore also recorded same failure modes with no significance towards a specific mode.[40]

This study disagreed with Gresnigt et al. (2020) who stated that change of material or design of RBFDP has no significant effect over fracture resistance. One major drawback of his study was 80 % failure in adhesion for zirconia group, another justification for disagreement is the direction of fracture test machine rod that was vertical to incisal edge which is not mimicking the natural bite on anterior teeth.[41]

Gresnigt et al. (2020) also studied mode of failure and noted some significance towards catastrophic root fracture with lithium disilicate. While zirconia group failed predominantly on adhesion level. More surface treatment for both tooth and zirconia surface was applied in this study. Also, different cementation material was used in this study. Both factors may justify the disagreement as in this study failure had no significance towards any mode.[41]

Al-Dwairi et al. (2023) stated that change in design or material of RBFDP is not of any significant change. He also pointed at significant effect of design over mode of fracture. He justified his finding to the short designs that had less surface area for adhesion and hence higher rate of adhesive failure mode was recorded with short wing designs over the longer wing designs. However, direct comparison with this study could be limited due to difference in framework design.[42]

This study agrees with Kasem et al. (2023) who concluded that change in design and material of RBFDP has significantly affected the load bearing resistance. His study included several RBFDP designs based on number and shape of wings. Materials selected were monolithic zirconia and zirconia reinforced lithium disilicate as materials of choice.[43]

Yildiz et al. (2024) agreed to the significant effect of material choice over fracture resistance. in his study he compared monolithic zirconia to lithium disilicate over different restoration thicknesses. Monolithic zirconia showed significant increase of resistance to fracture when the thickness of restoration was decreased.[44]

This study has several limitations that should be acknowledged:

There were only a certain number of analyzed samples. Only one brands of zirconia and one brand of Lithium Disilicate were evaluated; other brands should to be examined. Since achieving ideal natural tooth consistency was nearly impossible, the used teeth had a narrow range of sizes. This study did not use artificial periodontal ligaments, which could have affected the data and findings. The restorations underwent an artificial thermal aging procedure for a duration of one year. Consequently, long-term artificial aging experiments are required. In this investigation, no mechanical aging was done. Cantilever pontic and single-tooth retainers have only been studied in a small number of clinical trials, and the findings do not indicate any issues. (73.74) These initial findings using RBFDPs built with the altered designs are encouraging. Before these restorations can be suggested for widespread therapeutic usage, however, more clinical research is necessary.

CONCLUSION

Within the limitations of this in-vitro study this study, concluded that:

1. Changing design and material of RBFDP has significant effect on fracture resistance.
2. Regarding materials, zirconia was found to withstand significant higher fracture load than lithium disilicate.
3. Regarding design, fracture resistance was found to be the highest among groove modification design.
4. Adhesion failure is more common with zirconia than fracture failure. On the other hand, lithium disilicate favorite fracture failure over adhesion failure. With catastrophic failure being least recorded for both materials.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Zirconia should be preferred over lithium disilicate for anterior cantilever RBFDPs, especially in cases where high fracture resistance is required.
2. The groove modification design should be considered for enhancing the mechanical retention and fracture resistance of RBFDPs.
3. Future studies should explore the long-term clinical performance of zirconia and lithium disilicate RBFDPs with different retainer designs. Additionally, the effect of other surface treatment methods and resin cements on fracture resistance should be investigated.

Declaration of Competing Interests

The authors declare no conflicts of interest that could have influenced their study or findings.

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